2012 Science Demonstrations

The following science demonstrations were prepared and presented by the teacher candidates in the University of Northern Colorado's SCED 441/541 (Methods in Teaching Secondary School Science) in Fall 2012. Dr. Rob Reinsvold was the instructor for the course. Most of the demonstrations were presented at the 2012 Colorado Science Conference as "*30 Demos in 50 Minutes"*. This continued the tradition started by Dr. Courtney Willis over a decade ago.

Although each demonstration was tested by the teacher candidates, you are encouraged to test it yourself before using it for instruction. Often a slight change in materials can affect the success of the demo. Also, even though some safety considerations are mentioned, please use additional caution with any of the demos, especially if students will be using the demos.

You are free to use these demos if you like.

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Bubbling Lava Lamp

Shelby Hojio-Ratzlaff - Biology Senior

MATERIALS:

Clean, plastic bottle, glass, jar, or test tube
Vegetable oil
Food coloring
Water
Alka-Seltzer
Flashlight

PROCEDURE:

1. Fill the bottle ¼ of the way with water
2. Fill the rest of the bottle with vegetable oil
3. Add 10 to 20 drops of food coloring
4. Drop alka-seltzer tablets into the bottle
5. To make the lava lamp more Lava-like, turn the lights down and put your bottle over a flashlight

TIPS:

1. You can continue adding alka-seltzer as many times as you like.

EXPLANATION:

Oil and water do not mix and oil is less dense than water. The alka-seltzer tablets react with the water to make bubbles of carbon dioxide gas. The bubbles attach to colored water and float to the surface.

SAFETY:

When you drop the alka-seltzer tablets into the oil, be careful that no splatters of oil go into your eyes.

Dissolving Styrofoam

Shelby Hojio-Ratzlaff - Biology Senior

MATERIALS:

Tin pie pan
Styrofoam cup
acetone

PROCEDURE:

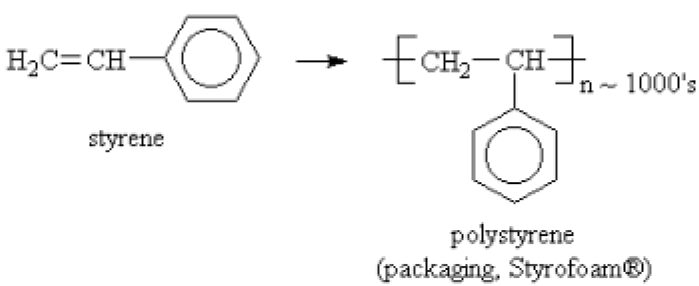
1. Fill the pie pan ¼ full with acetone
2. Place the Styrofoam cup in the acetone
3. Observe the Cup melt like the *Wicked Witch* from *The Wizard of Oz*

EXPLANATION:

Styrofoam is a polymer made from styrene. A polymer is made up of long chains that intertwine with each other. Alone, polystyrene is a hard plastic, to create soft Styrofoam, gas is bubbled through it as it polymerizes. When the cup is placed in acetone, the acetone serves as a lubricant between the polymer chains, this allows them to slide around each other, becoming a soft blob in the acetone. When the blob is removed and the acetone is allowed to evaporate it solidifies into hard plastic.

SAFETY:

Safety should be exercised when using acetone so as not to splatter in eyes.



Oil and Gas Production

Shelby Hojio-Ratzlaff - Biology Senior

MATERIALS:

1x2 wood board
1x6 wood board
Drill
¼ in drill bit
screw driver
air compressor
½ inch clear tubing
2- 3/4in hose clamps
5- 2x ¼ in steel fittings
2- ¼ in steel T's
¼ in 90 degree fitting
2- ¼ in plugs
3- ¼ in ball valves
1 roll ½ in steel pipe tape
1 roll ½ in pipe strapping
6- 12x ¾ in screws
3- 12x 1 ½ in screws
1 liter clear plastic bottle with screw on lid
¼ in push connect
¼ in break line
200 Scrubber pot
Water
Food coloring
pipette
(all parts are available at any local hardware supply, except the 200 scrubber pot which can be found at a specialty oil field supply store)

SETUP:

1. Screw wood boards together to make an upside down T with the 1x6 board at the bottom.
2. Tape the threads on the ¼ in push connect and tighten securely into ¼ ball valve.
3. Tape the threads on one of the 2x ¼ in steel fitting and thread into the other side of the ball valve from step 2.
4. Screw one of the ¼ in steel T's onto the open threads of the steel fitting from step 3. Make sure the T is upside down in this process. It should look like this.
5. Screw another 2x ¼ in steel fitting into the T at the exposed right end.
6. Screw a ball valve onto the steel fitting you added to the T in step 5.
7. Screw the scrubber pot into the ball valve from step 6.
8. Working upward from the exposed top end of the T. Screw another 2x ¼ in steel fitting into the top of the T.
9. Stretch the ½ in clear tubing around the threads of the steel fitting from step 8.
10. Place a hose clamp around the clear tubing and tighten around the threads of the steel fitting from step 8.

11. Stretch the other end of the tubing over another 2x ¼ in steel fitting.
12. Place a hose clamp around the clear tubing and tighten around the threads of the steel fitting from step 11.
13. Tape the exposed threads of steel fitting from step 11.
14. Screw a ball valve onto the threads of the steel fitting.
15. Screw another 2x ¼ in steel fitting in the open end of the ball valve.
16. Screw a ¼ in T onto the steel fitting. ⊣ The T should look like this.
17. Screw a ¼ plug into the top of the T. Leave loose so that it can be removed for the demonstration.
18. Tape another 2x ¼ in steel fitting on both sides.
19. Screw the steel fitting into the last opening of the T, left side.
20. Screw the ¼ in 90 degree fitting onto the exposed threads of the steel fitting from step 19.
21. Tape one side of the last 2x ¼ in steel fitting.
22. Screw the taped end into the 90 degree fitting.
23. Take the cap off of the 1 liter clear bottle.
24. Drill a ¼ in hole in the top of the cap.
25. Thread the steel fitting into the cap.
26. Screw the bottle into the cap.
27. Use the pipe strapping to secure the steel fitting to the 1x2 wood board above the bottom T using screws and screw driver.
28. Use the pipe strapping to secure the clear tubing towards the top of the apparatus below the ¾ in hose clamp around the clear tubing. Use the screws and screw driver to hold in place
29. Use more pipe strapping to secure the 1 liter bottle to the apparatus.
30. Wrap the pipe strapping around the 1 liter bottle and around the 1x2 wood board making sure the strapping goes between the board and the clear tubing.

PROCEDURE:

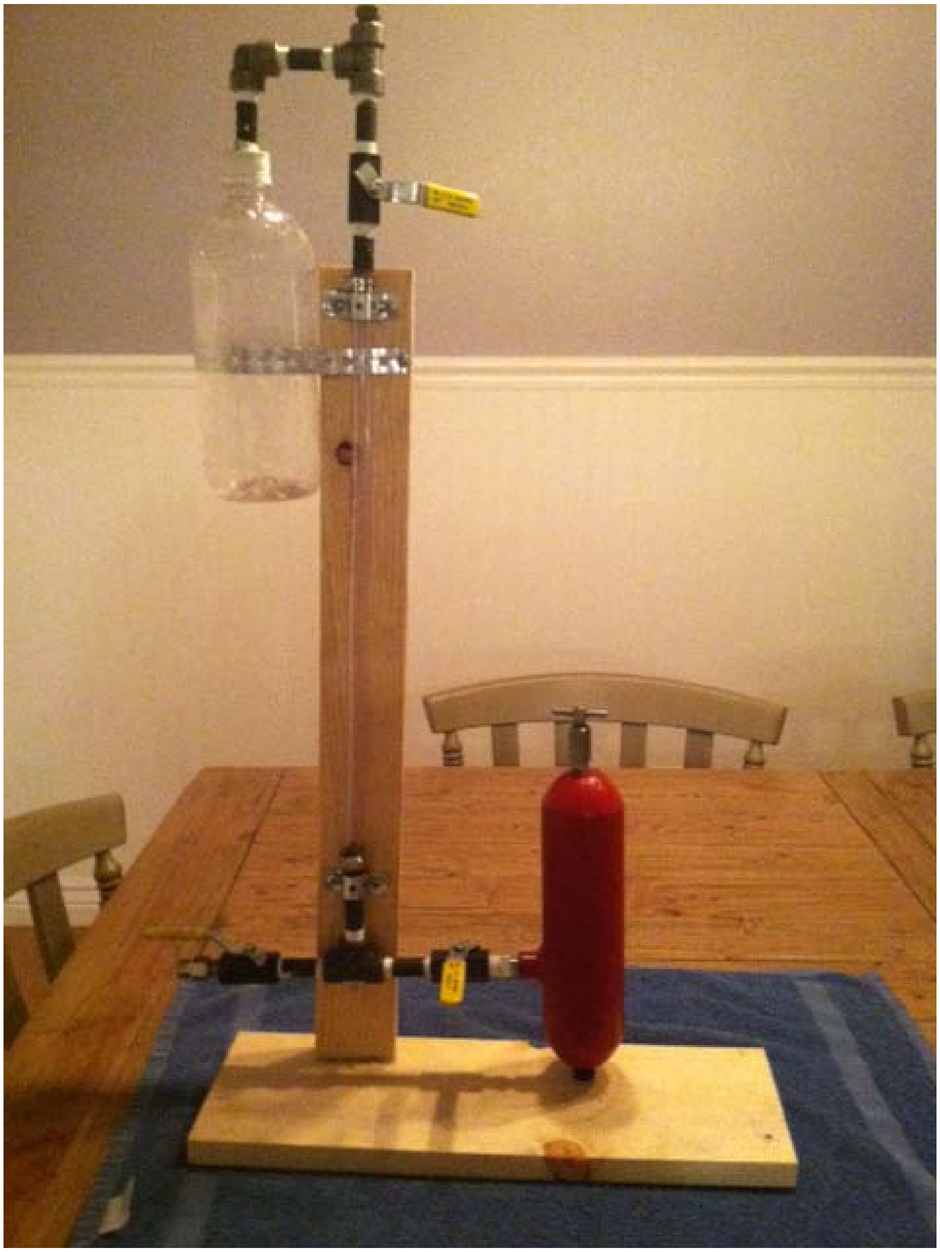
6. Fill the scrubber pot with air by opening the two ball valves at the bottom and making sure the ball valve at the top is closed.
7. Using the air compressor place the nozzle into the ¼ in push connect on the left hand side of the apparatus.
8. Fill the scrubber pot to approximately 60psi.
9. Close the bottom valves before taking the nozzle off of the push connect to ensure the psi does not leak.
10. Take the plug out of the T at the top of the apparatus
11. Open the top valve, expect a small amount of pressure to be released.
12. Put food coloring into the water
13. Pipette water into the top T to fill the clear tubing half way full.
14. Replace the plug at the top of the T.
15. To demonstrate oil coming to surface using down hole pressure slowly open the ball valve on the right hand side closest to the scrubber pot.
16. The water should move up the tubing and into the 1 liter bottle.

EXPLANATION:

This apparatus demonstrates how natural gas is used to move oil from sandstone formations that are approximately 7,000 to 8,000 feet below the surface of the Earth. The scrubber pot is acting as the sandstone formation. This formation is porous, it stores oil and gas. Before a well can produce, the formation must be fractured, creating roadways for oil and gas to come to the bottom of the hole that was drilled, also called a well boar. Opening the ball valve simulates how pressurized natural gas from the sandstone formation pushes oil to the surface. Oil will enter a production tank (the one liter bottle), where it will be stored until it is transported to a refinery. The natural gas that brings the oil to surface will be burned off or sold down a gas gathering system.

SAFETY:

There are pressurized items involved with this apparatus. Caution should be taken while handling the apparatus when it is pressurized. Always open valves SLOWLY so that all parts stay secure.



Floating Finger Sausage

Shelby Hojio-Ratzlaff - Biology Senior

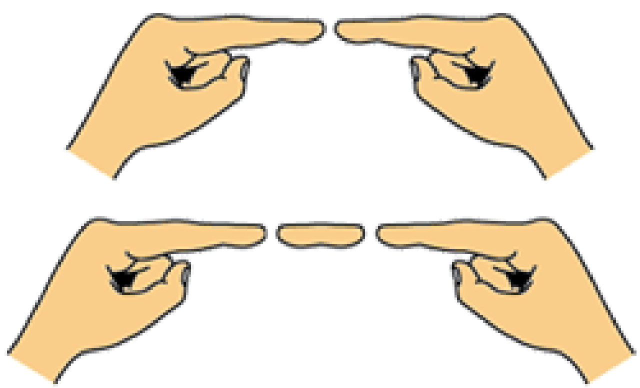
MATERIALS:
Two fingers
Two eyes

PROCEDURE:

1. Extend your arms out in front of you
2. Place your index fingers pointed at each other in front of your face at eye-level.
3. Your finger tips should be approximately 1 inch apart.
4. Focus your eyes on something in the distance.
5. Between your fingers you should see a floating finger or sausage in the overlapping region.

EXPLANATION:
Our eyes are only a few centimeters apart from each other, each sees a different image, but the brain combines the two images. When we relax our eyes, the two images overlap, allowing you to see a combination the images, creating the floating sausage.

SAFETY:
As the majority of people have these materials around them at all times, safety should not be an issue. However, please be sure not to poke yourself in the eye.



Disappearing Balls

Casey Coy – Earth Science Senior

MATERIALS:

Clear glass bowl
2 ping-pong balls
several metal balls or marbles
A bag of pinto beans

SETUP:

Have all materials ready on table to be placed into bowl at specific times.

PROCEDURE:

Pour pinto beans over the ping-pong balls so that the ping-pong balls are completely covered. Next, place metal balls or marbles on top of the pinto beans. After materials are placed in the bowl gently shake the bowl until the ping-pong balls rise to the top and the metal balls or marbles sink to the bottom.

TIPS:

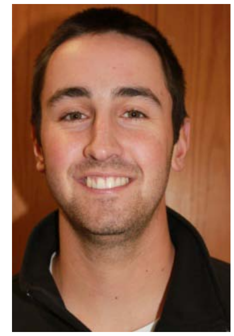
Do not shake the bowl too violently as you will not see a good result. Best results happen when bowl is gently shaken back and forth.

EXPLANATION:

As you shake the bowl each of the various components will separate according to its relative density. The metal balls will sink from the top to the bottom, the pinto beans should stay in the middle and the ping-pong balls will rise to the top of the bowl. This demonstration visually shows how differing densities separate in a solution. An earth science application would be in a geologic setting where different densities of sediment settle out in either a river or sediment bed. Could also be used in chemistry to illustrate the property of density.

SAFETY:

Make sure students are warned of allergy risks.



Tension Cracks in Cheese

Casey Coy – Earth Science Senior

MATERIALS:
Cheese squares (Kraft singles work best)
Straight edge (butter knife works)

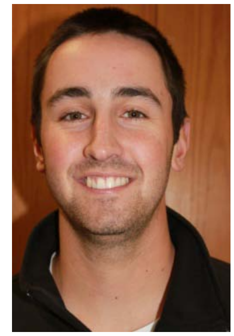
SETUP:
Have all materials ready on the table and take cheese out of its packaging.

PROCEDURE:
Either take one piece of cheese for a class demonstration or distribute cheese slices to entire class for best results. Gently make incisions to the cheese with your straight edge or knife. Place fingers on the edges of the cheese slice perpendicular to the incisions and pull apart the cheese slowly and gently. Experiment with varying patterns of incisions in the cheese to simulate cracks in the Earth's surface.

TIPS:
Do not pull the cheese slices with too much force as they will likely break at the wrong points. Pull with even force very gently to achieve realistic results.

EXPLANATION:
The Kraft single acts like the Earth's crust. Just like on Earth there are cracks in our surface that are susceptible to differing forces. When forces are applied to the surface of the cheese or crust, weak points are revealed and show the results of the force by breaking and separating even more. This demo can be used in classroom to demonstrate tension forces and their results in the real world. Everyday example where this happens is in asphalt. Cracks in asphalt are the result of forces that are acting on the surface and the cracks are the weakest points in the asphalt.

SAFETY:
Make sure students are warned of allergy risks to dairy products.



Dirty Laundry Analogy

Casey Coy – Earth Science Senior

MATERIALS:

Item – Full laundry basket

SETUP:

Simply have a naturally full laundry basket ready to take apart.

PROCEDURE:

Place the laundry basket up at the front of the classroom and ask the class to describe what sort of timetable is involved in it. Try and allude to the fact that each layer of clothing is part of a certain event in time and usually the clothes on top are worn more recently (younger) than the clothes on the bottom. Start by pulling the clothes on the top out of the laundry basket and have the class make some observations about. Do this until you reach the bottom of the laundry basket.

TIPS:

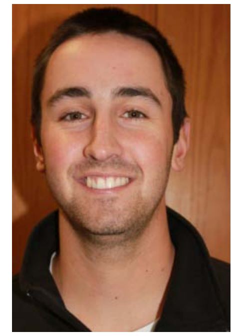
Might be appropriate to make sure there are no undergarments in the laundry basket for the students to comment on. Also, use a more vertical laundry basket to allow for more observations.

EXPLANATION:

The dirty laundry analogy is similar to that of the law of superposition in geology. In geology rocks that are near the top of the crust are generally younger than those towards the bottom of the rock column. Students are able to compare the two and see the correlation to stratigraphy in geology. Also, it demonstrates that rock layers usually have similar properties and were deposited under similar conditions. In the case of the laundry basket similarities in clothing type can tell us what sort of weather with which the clothes were as well as what they person may have been doing during that time.

SAFETY:

No safety considerations needed.



Peanut Butter Ridge

Casey Coy – Earth Science Senior

MATERIALS:

Two graham crackers
Jar of peanut butter

SETUP:

Spread peanut butter flat on a flat surface and place graham crackers on top of peanut butter.

PROCEDURE:

Place graham crackers together so their edges are touching over the peanut butter. Apply downward pressure to the graham crackers and slowly pull the graham crackers apart so they are not touching anymore. Continue to apply pressure downward as you pull the crackers apart causing the peanut butter to “ooze” from the center.

TIPS:

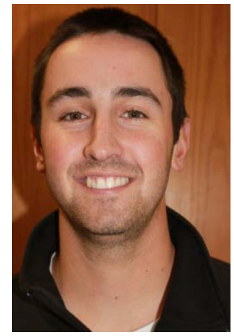
Separate the crackers slowly so the peanut butter has a chance to move out from under the graham crackers.

EXPLANATION:

This demonstration is designed to illustrate a mid-ocean ridge. Since humans have rarely captured this spot before we are able to recreate the crust (graham crackers) and the magma (peanut butter) that interacts at mid-ocean ridges. At mid-ocean ridges there is divergence and volcanic activity that creates new crust along each zone in the world. In this demonstrations case students are able to view the processes and results of a divergent boundary near a mid-ocean ridge.

SAFETY:

Make students aware of the use of peanut products.



Meteor Burnout

Casey Coy – Earth Science Senior

MATERIALS:
Large soda bottle
1/2 an alka seltzer tablet

SETUP:

Simply have a large soda bottle filled with water ready for observation.

PROCEDURE:

Remove lid from top of bottle and drop a 1/2 of a piece of an alka seltzer tablet so it descends to the bottom of the bottle. Observe the effects of the alka seltzer tablet as it descends to the bottom of the bottle.

TIPS:

The bigger the bottle the better the results.

EXPLANATION:

This demonstration illustrates what happens as a meteor or comet is torn apart either in the atmosphere or in space. As the tablet descends to the bottom it will break apart a leave a trail of debris just like a meteor or comet would do in real life. Students can make observations and discuss them as class.

SAFETY:

No safety considerations.

Earthquakes and Tuning forks

Justin Little- Earth Science Senior

MATERIALS:

Tuning Fork
Table (slate topped tables work very well, but almost any table will work)

PROCEDURE:

1. Ring tuning fork
2. Place on table top and listen

EXPLANATION:

The sympathetic vibration of the tuning for is causing the whole table to vibrate. These waves are propagating through the whole table just as the waves of an earthquake will. The waves travel in all directions as demonstrated by the whole table becoming the "speaker."

Crunching Cans with Heat

Justin Little-Earth Science Senior

MATERIALS:

Aluminum soda cans
Water
Ice Water
Hot plate
Tongs to hold can

SETUP:

PROCEDURE:

1) Pour just a little water into aluminum can
2) Heat can on hot plate until water is boiling
3) With tongs, quickly take can and flip over into ice water

TIPS:

Add any useful tips that would help to make the demo successful such as the specific concentration of a chemical.

EXPLANATION:

This shows how the volume of a gas changes with temperature. The hot water vapor expands to fill the can and then when that gas is in contact with the ice water, it will cool rapidly causing a vacuum in the can. The vacuum will cause the can to crumple.

SAFETY:

Be careful with the hot aluminum cans, they will get hot enough to burn.

Rocks can fold?

Justin Little-Earth Science Senior

MATERIALS:

Paper towel
Water
Flat surface/ table
Document Projector (optional if students cannot crowd around a single table)

PROCEDURE:

1. Paper towel on table and push edges toward each other
   a. Will cause the towel to bow up in the middle: Large Scale Folding
2. Flatten towel back out and then mist with water until wet
3. Push edges toward each other again
   a. Will cause small wrinkles over the surface of the towel: Folding on a Small scale

EXPLANATION:

The paper towel represents a layer of rock, and pushing the ends toward each other represents the pressure possibly caused by plates colliding. When the paper towel is dry, there will be a large bulge in the middle of the paper towel. This represents large scale folding like an anticline. When the paper towel is wet, this represents a layer of rock with pressure coming from above, so only small folds can be created.

Faulting

Justin Little-Earth Science Senior

MATERIALS:
3 large sheets of Butcher paper (at least 2 different colors)

SETUP:
Cut two of the sheets into strips of different colors and glue them onto the other sheet creating layers of "rock" with different thicknesses. On
Once dry, cut the paper in to two pieces along an angle creating your foot and hanging walls.

PROCEDURE:
Once the rock layers are created with a fault, move one piece up and one down along fault to demonstrate normal and reverse faults

TIPS:
May want to cut all there pieces into strips and glue together so you can show that the fault can go both ways (i.e., foot wall is not always on right side of the fault)

EXPLANATION:
The different colored strips of paper represent different layers of rock. Cutting the paper creates a fault in the rock record and is used to show the distinction between the foot and hanging walls. This is a very visual demonstration of the rocks moving.

Geologic Timeline on a Roll of Toilet Paper

Justin Little-Earth Science Senior

MATERIALS**:**
1 roll of perforated toilet paper
Felt tipped marker

SETUP:
Can be done as a class activity or as a demo.
If a demo: Mark down all dates and events listed on the time line sheet. This takes about an hour to write down dates and re-roll the toilet paper.

PROCEDURE**:**

1. Unroll toilet paper explaining important periods in time.
2. End with how much of the roll of toilet paper roll is taken up by human existence.

EXPLANATION**:**

Each square of toilet paper represents 20 million years on the timeline.
Below are dates and square numbers for the timeline

Sheets	Event	Geological time (Number of years before present)	Comments
0.00	*Present*	*0*	
0.0005	Modern man	10,000	
0.01	Neanderthal man	100,000	
0.03	First use of fire	500,000	
0.06	Worldwide glaciation	1,100,000	
0.07	Homo erectus	1,300,000	
0.08	Linking of North and South America	1,500,000	
0.08	Oldest stone tools	1,600,000	

0.15	**Beginning of Quaternary period (end Tertiary/Neogene)**	**3,000,000**	
0.15	Australopithecus	3,000,000	
0.50	Beginning of Antarctic ice caps	10,000,000	
0.50	Opening of Red Sea	10,000,000	
0.75	Formation of Himalayan Mountains	15,000,000	
1.15	**Beginning of Tertiary/Neogene period (end Paleogene)**	**23,000,000**	
1.25	First evidence of ice at the poles	25,000,000	
2.00	Collision of India with Asia	40,000,000	
2.50	Early horses	50,000,000	
2.50	Separation of Australia and Antarctica	50,000,000	
3.00	Early primates	60,000,000	
3.00	Opening of Norwegian Sea and Baffin Bay	60,000,000	
3.00	Alps form	60,000,000	
3.25	**Beginning of Tertiary/Paleogene period**	**65,000,000**	
3.25	**Beginning of Cenozoic Era**	**65,000,000**	**"recent life"**
3.25	**Cretaceous Period, Mesozoic Era end**	**65,000,000**	
3.25	Dinosaurs became extinct	65,000,000	
4.00	Rocky Mountains form	80,000,000	
7.00	**Cretaceous Period begins (Jurassic ends)**	**140,000,000**	
7.50	Early flowering plants	150,000,000	
9.00	Early birds and mammals	180,000,000	
10.40	**Jurassic Period begins (end Triassic)**	**208,000,000**	
11.00	Opening of Atlantic Ocean	220,000,000	
12.25	**Triassic Period begins**	**245,000,000**	
12.25	**Beginning of Mesozoic Era (end Paleozoic)**	**245,000,000**	**"middle life"**
14.00	Final assembly of Pangaea	280,000,000	
14.50	**Beginning of Permian period (end Carboniferous/Pennsylvanian)**	**290,000,000**	
16.25	First reptiles	325,000,000	
16.15	**Beginning of Carboniferous/Pennsylvanian period (end Mississippian)**	**323,000,000**	
18.15	Early trees, formation of coal deposits	363,000,000	

18.15	**Beginning of Carboniferous/Mississippian period (end Devonian)**	**363,000,000**	
20.45	**Beginning of Devonian period (end Silurian)**	**409,000,000**	
21.50	Early land plants	430,000,000	
21.95	**Beginning of Silurian period (end Ordovician)**	**439,000,000**	
24.50	Early fish	490,000,000	
25.50	**Beginning of Ordovician period (end Cambrian)**	**510,000,000**	
28.50	Early shelled organisms	570,000,000	
28.50	**Beginning of Cambrian period (end of Precambrian time)**	**570,000,000**	**rise of multicellular animals**
28.50	**Beginning of Paleozoic Era**	**570,000,000**	**"ancient life"**
28.50	**Beginning of Phanerozoic Eon (end Proterozoic)**	**570,000,000**	**"visible life" (or 544 million years ago)**
35	Early multicelled organisms	700,000,000	
40	Breakup of early supercontinent	800,000,000	
70	Formation of early supercontinent	1,400,000,000	
60	First known animals	1,200,000,000	
125	**Beginning of Proterozoic Eon (end Archeon)**	**2,500,000,000**	**"earlier life"**
135	Buildup of free oxygen in atmosphere	2,700,000,000	
170	Early bacteria & algae	3,400,000,000	
190	Oldest known Earth rocks	3,800,000,000	
200	**Beginning of Archeon Eon**	**4,000,000,000**	
230	**Precambrian time begins**	**4,600,000,000**	
230	Origin of earth	4,600,000,000	

Note: I've set the scale to use 230 sheets rather than the usual 250 because it makes the conversion more obvious -- 20 million years per sheet.

Bimetallic strip and thermal energy

Casey McGaughey Earth Science-senior

MATERIALS:
1 stainless steel, nickel bimetallic strip
1 small candle
method for lighting the candle

SETUP:
Light candle, hold bimetallic strip on edge over the flame.

PROCEDURE:
The above set up covers the extent of the demo, hold the strip over the flame until the desired amount of deformation has been reached.

TIPS:
Follow the above procedure.

EXPLANATION:
Metals have different coefficients of expansion where change in length is directly proportional to the product of the linear coefficient of expansion, the length of material, and the change in temperature ($\Delta L = A x L x \Delta T$). As the strip is heated the differing coefficients of expansion lead to different expansion rates of each of the two types of metal in the strip causing an otherwise straight strip of metal to bend, the more the strip is heated the more it will bend.

SAFETY:
Caution must be used with the lit candle.

Effects of temperature on chemical luminescense

Casey McGaughey-Earth Science Senior

MATERIALS:

Two chemical light sticks
Ice water in a container
Hot water in a container

SETUP:

You will need clear containers to hold hot and ice water while allowing the light sticks to be visible.

PROCEDURE:

Break the internal ampule of the light sticks; insert one in the ice water and the other in the hot water. Compare the glow of each given the temperature difference of the water the light in the warmer water should be much brighter than the light in ice water, due to the speed of the reaction occurring within each light stick.

TIPS:

Ensure a fairly large difference in water temperature.

EXPLANATION:

The light produced by the light stick is the result of a chemical reaction; temperature affects the speed at which a chemical reaction takes place. The hot water will speed the reaction up producing a brighter light than the ice water. If left long enough to complete the reaction and stop illuminating it would be found that the light in the ice water lit for much longer than the light in hot water.

SAFETY:

There are none as long as hot water is used to heat the light and not a microwave or boiling water.

Can with internal inertial mass

Casey McGaughey-Earth Science Senior

MATERIALS:

Coffee Can
Item with mass greater than that of the can
One or two rubber bands to hold mass centered in coffee can
two toothpicks or small nails
tape or something to tie mass to rubber band/bands

SETUP:

Drill holes in bottom and top of coffee can; attach inertial mass to rubber band, put loop of rubber band out holes, insert toothpicks through loops to secure and center mass in coffee can.

PROCEDURE:

Roll the coffee can on a flat smooth surface, the mass weighing more than the coffee can will remain in the same relative position inside the coffee can winding the rubber band as the coffee can rolls forward. When the initial kinetic energy provided by the push is gone the rubber band will have wound enough that energy stored will be released because the mass of the center item is greater than the coffee can this energy will be released as movement of the coffee can in the opposite direction.

TIPS:

Trial and error may be needed to find a mass rubber band combination that does what is desired.

EXPLANATION:

This is a good demonstration of energy conversion from kinetic energy to potential energy and then back to kinetic energy .

SAFETY:

There are no safety concerns other than the possible breakage of the rubber band.

The Live Wire

Casey McGaughey

MATERIALS:
Item 1 Nitinol wire, a nickel and titanium alloy
Item 2 very hot water

SETUP:
Bend twist and otherwise deform the piece of nitinol wire.

PROCEDURE:
Place deformed wire in hot water bath.

TIPS:
Ensure the water is very hot the wire needs this thermal energy to return to its original shape.

EXPLANATION:
Nitinol is a wire that has been heat treated and thus has a memory. Any deformation can be reversed by the addition of heat the wire turns the thermal energy into motion. It is used in space to control robotic arms, in greenhouses for temperature control, and by orthodontists in the wire for braces.

SAFETY:
Some caution is required while handling the hot water.

The apple battery

Casey McGaughey-Earth Science Senior

MATERIALS:

1 apple
1 Micro ammeter, could use multi-meter if micro ammeter is not available
large, medium, and small zinc nails
large, medium, and small gauge pieces of bare copper wire (about 4" long)

SETUP:

Largest needle deflection (current is produced by the large nail and heavy gauge wire) Insert each into apple about one centimeter notice deflection, increase insertion depth another centimeter note increased current.

PROCEDURE:

Insert one nail and one piece of copper wire into apple about one centimeter deep, make sure they do not touch inside the apple. Connect the ammeter to each electrode, positive to the copper wire and negative to the zinc electrode. There will be needle deflection on the ammeter indicating current flow produced by the chemical reaction of the apple with the two dissimilar metals.

TIPS:

Use the larger electrodes for demo purposes allow the students to experiment with electrode size and depth of insertion to investigate DC current produced by this simple battery.

EXPLANATION:

It is the malic acid within the apple that allows the two electrodes used to produce an electric current.

SAFETY:

There are no major safety concerns.

Laura Pedersen

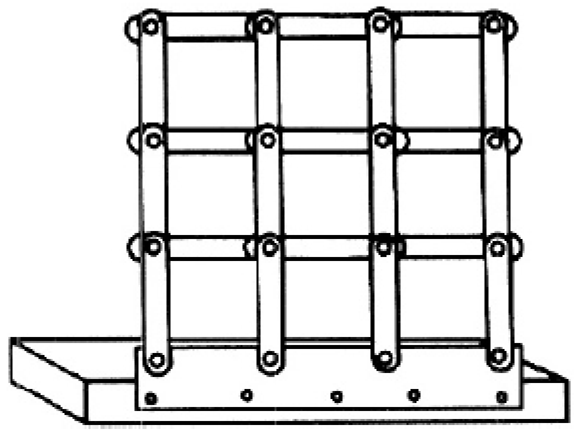
Can Buildings be Safer?

Laura Pedersen – Earth Science Senior

MATERIALS:

Materials needed to assemble one building model

1. 21 jumbo craft sticks,
   a. about 15cm x 2 cm x 2 mm thick sticks
   b. Paint sticks may be a cheaper alternative
2. Electric drill with 3/16" bit
3. 1 piece of thin wood (about 2 mm thick) about 18 in. x 2 in
4. 1 piece of sturdy wood (2 x6) for a base (about 18 in long)
5. 16 machine bots, 10 x 24, about ¾ in
6. 16 machine screw nuts (10 x 24)
7. 32 washers, #8
8. Small wood screws



Materials for demonstration

1. Stock paper (15cm x 15cm squares)
2. 10-15 Paper clamps
3. String
4. Strips of paper

SETUP:

1. Build the wall beforehand
2. Stack 21 craft sticks one on top of the other. Wrap a rubber band around the center to hold them together.
3. Using a 3/16 in. bit, carefully drill a hole through all the sticks at once, 1 cm from the end of the stack.
4. Drill slowly to avoid cracking the wood.
5. Select the thinner of the two large pieces of wood (45 cm x 6 cm).
6. Drill a 3/16 in. hole 1 cm from one end and 1 cm from the edge.
7. Measure the distance between the holes drilled in the craft sticks and space three more 3/16 in. holes at that distance 1 cm from the edge so that a total of four holes are drilled
8. Use the small wood screws to mount this piece of wood on the base (the 2 x 6), fastening at the bottom and in the center.
9. Leave the pre-drilled holes sticking up far enough above the top to accept the drilled craft sticks
10. Using the bolts, washers, and nuts, assemble the craft sticks to build a model wall
11. Experiment with tightening bolts and washers until they are just tight enough for the wall to stand on its own

PROCEDURE:

1. Show students building and tell them that it represents a 3-story building
2. Demonstrate what happens to the building during an earthquake by shaking the structure
3. Ask students if they noticed which story collapsed first
4. Then add support to only the first story and simulate another earthquake
    a. Will supporting the first story keep the entire building up?
5. Repeat these steps with all of the stories, until the building stays upright during earthquake

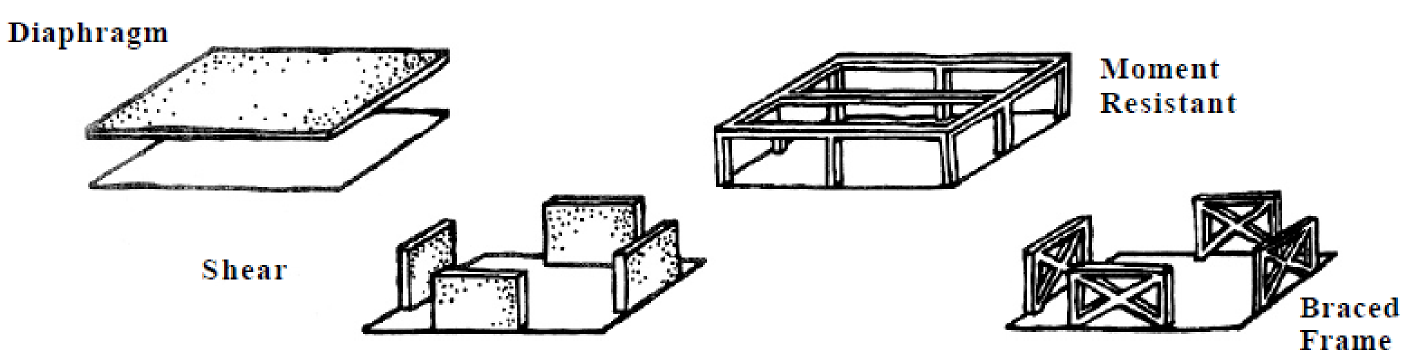
TIPS:

1. Do not tighten the screws all the way. They should be just tight enough to hold the building up
2. The craft sticks are very fragile, while constructing building, drill with smaller drill bit and work up to larger bit

EXPLANATION:

During an earthquake, the ground motion that is important in determining the forces on a building is acceleration. As the seismic waves move through the ground, the ground moves back and forth. In a building with a mass in the thousands of metric tons, tremendous forces are required to produce the same motion. These forces are transmitted throughout the structure, so if the movement repeats for some minutes the building may shake to pieces. To overcome the effects of these forces, engineers rely on a small number of components that can be combined to form a complete load path.

Different structural support systems are used: diaphragms, shear walls, braced frames, and moment-resistant. This demonstration shows how some of these support structures can direct the forces back to the ground. In a simple building with shear walls at each end, ground motion enters the building and moves the floor diaphragms. This movement is carried by the shear walls and transmitted back down through the building to the foundation. Braced frames act in the same manner as shear walls, but may not carry as much load depending on their design.



SAFETY:

No safety concerns for this demonstration, but use caution during construction of model

Laura Pedersen

CO_2 Bubble

Laura Pedersen – Earth Science Senior

MATERIALS:

1. Old T-shirt cut into long narrow strips
2. Liquid Dish Soap (like dawn)
3. Cup
4. Water
5. Large Bowl
6. Dry Ice (~ 1/2 pound)

SETUP:

1. Put large concentration of soap and water in cup
2. Submerge the strips of T-shirt into dish soap mixture
3. Fill the large bowl with water

PROCEDURE:

1. Place the dry ice into the bowl of water
2. Glaze the rim of the bowl with soapy T-shirt
3. Scrape the rim of the bowl with the T-shirt

TIPS:

1. Try not to get any soapy water into the bowl, for it will make the bubble pop more often.
2. Scraping the T-shirt slowly, rather than fast, will help make the bubble stay on the bowl.
3. This can be done on a smaller scale as well; using cups instead of bowls.

EXPLANATION:

This demonstration is showing the process of sublimation in a more creative way. Sublimation is the process of transformation directly from the solid phase to the gas phase without passing through an intermediate liquid phase. Sublimation is an exothermic process that occurs at temperatures and pressures below a substance's triple point in its phase diagram. Additionally, this demonstration can represent what happens when gases remain under pressure; which is demonstrated as the gas builds up under the soapy film and continues to expand until it pops.

SAFETY:

1. Dry ice can burn skin - Use gloves whenever handling dry ice.
2. Never put dry ice into closed container

Laura Pedersen

Defying Gravity – Lenz's Law

Laura Pedersen – Earth Science Senior

MATERIALS:

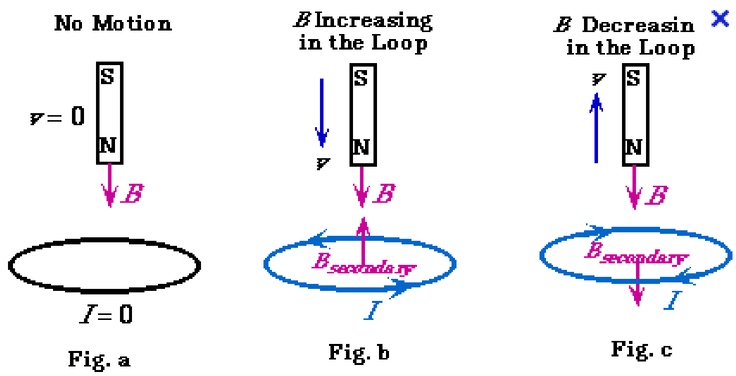
1. One copper pipe (at least 2 ft in length)
2. Strong magnet (neodymium)
3. PVC pipe; same length as copper pipe (Optional)

SETUP:

No setup is required!

PROCEDURE:

1. Drop the magnet into the PVC pipe
2. Have students count the time it takes to exit the PVC pipe
3. Show students that the magnet does not stick to the copper
4. Drop the magnet into the copper pipe
5. Have the students count the time it takes to exit the copper pipe



EXPLANATION:

Lenz's law states, "There is an induced current in a closed, conducting loop if and only if the magnetic flux through the loop is changing. The direction of the induced current is such that the induced magnetic field opposes the *change* in the flux."

In layman's terms, the magnetic field of a magnet creates a downward flow through the copper pipe and as it is pushed closer to the pipe, the magnetic field increases. To oppose this change, as Lenz's law requires, the pipe will generate an upward-pointing magnetic field. Thus as the magnet approaches the pipe, the pipe induces a counterclockwise current around the pipe to oppose this increase of magnetic field. Once the magnet stops moving (changing), then the induced current will cease as well.

SAFETY:

1. Neodymium magnets are **VERY** strong and should not be handled by anyone who:
    a. Has a pacemaker
    b. Has a Diabetic pump
2. May pinch skin when handling with two neodymium magnets
3. May be fatal if consumed – do not let children play with magnets
4. Neodymium magnets will ruin cell phones, credit cards, computers, etc. if placed near these types of items

Laura Pedersen

Sun Distribution & Earth's Seasons

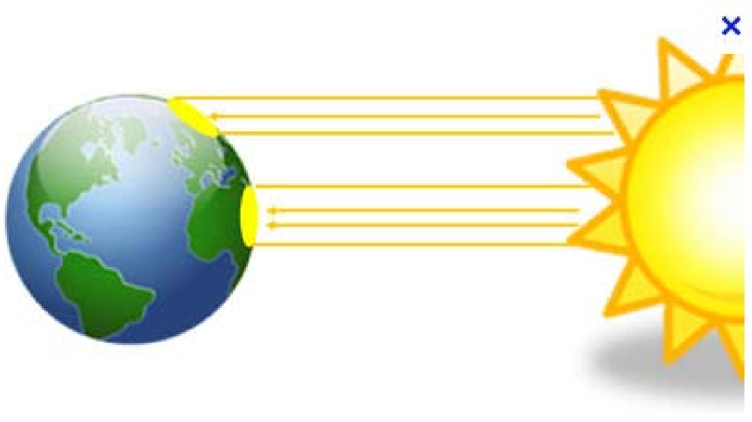
Laura Pedersen – Earth Science Senior

MATERIALS:

1. Peg Board
2. Ball (Dark color for presentation purposes
3. Bright light (overhead projector)

SETUP:

1. No setup required



PROCEDURE:

1. Shine the light through the peg board onto sheet of dark paper
2. Show students that the light (energy) is distributed evenly
3. Shine the light on the ball
4. Show students that the light spreads with the curvature of the Earth
    a. This represents direct and indirect light
5. Then draw in a line to represent the equator
6. Then tilt the Earth to show the students that the tilt is what creates seasons

TIPS:

Experiment with the peg board and light to determine appropriate distances

EXPLANATION:

Many students have a misconception about how Earth gets its seasons. Many believe that during summer we are just simply closer to the sun and vice versa. Although once a year we are closer to the sun (perihelion), it is actually during the Northern Hemisphere's winter. This demonstration illustrates to students that seasons are created due to the Earth's tilted axis as well as the energy distribution. Because the globe is round, the sun's incoming energy is more concentrated on some portions of the earth than in others. Lower latitudes, near the earth's equator, receive a greater concentration of incoming energy than higher latitudes. This is because at higher latitudes, the same amount of incoming energy is spread over a larger area of the earth than at lower latitudes. Because of the tilt of the earth, during certain times of the year the northern hemisphere is tilted toward the sun; at other times, the southern hemisphere is tilted toward the sun. Accordingly, the region of the globe receiving the most concentrated rays changes. It is this phenomenon that results in seasons.

SAFETY:

No safety precautions needed during this demonstration

Laura Pedersen

Wilson's Cycle – Ocean Evolution

Laura Pedersen – Earth Science Senior

MATERIALS:

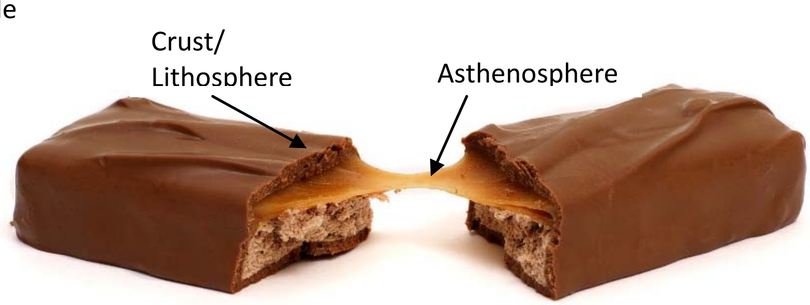
1. Fun-sized Milky Way candy bars (one per student)
2. Handout/Overhead copy of Wilson's cycle

SETUP:

No setup is required!

PROCEDURE:

1. Pass out Milky Way bars to students
2. Pass out handouts or project copy of Wilson's cycle
3. Stage one: Embryonic
    a. Milky Way bar "untouched"
4. Stage two: Juvenile
    a. Have students slowly pull candy bar apart, but not too much
    b. This illustrates that the crust has just broken
5. Stage three: Mature
    a. Have students pull a little bit more, but not completely apart
    b. At this point the caramel should be drooping, representing the asthenosphere
6. Stage four: Declining
    a. Have students start pushing their candy together, but not quite all the way
    b. If possible, have them push it together at an angle to represent a subduction zone
    c. This illustrates a convergence/subduction zone
7. Stage five: Terminal
    a. Have students push their candy all the way together
    b. This represents convergence with uplift
8. Stage six: Suture
    a. Have students push their candy even further; smashing the chocolate together
    b. This represents mountain building (like Himalayas)

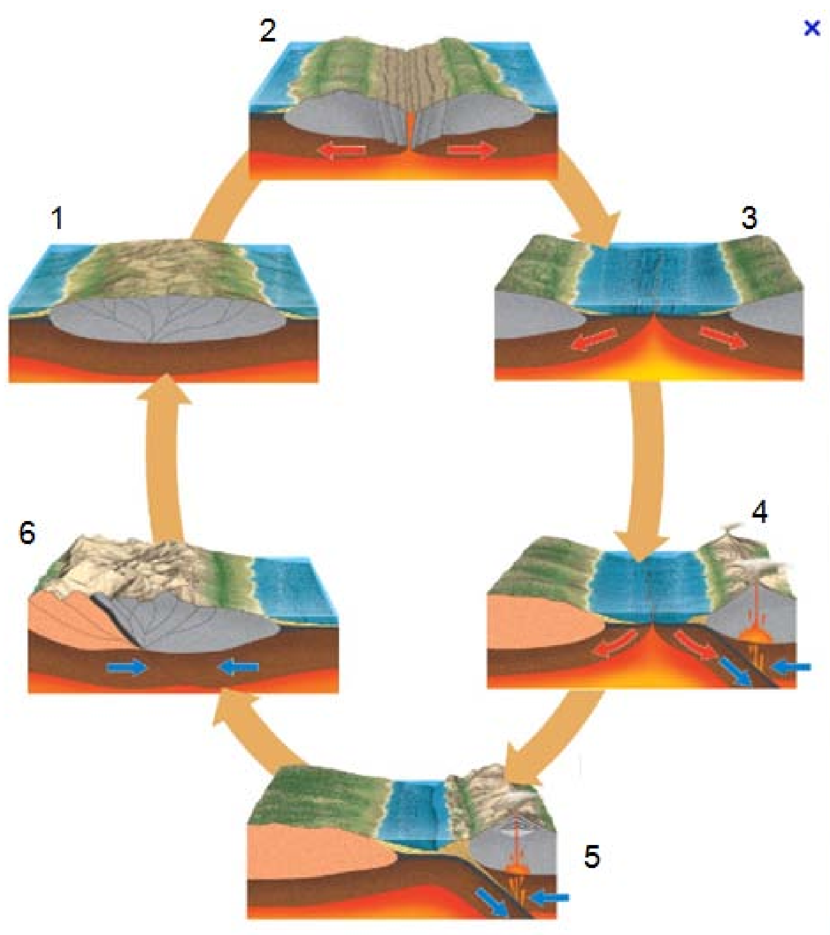


EXPLANATION:

As most of us know, the oceans open and close throughout time, the Wilson's cycle explains how the oceans evolve throughout time. As shown in the figure below, there are six stages affiliated with the Wilson's cycle and they are as follows: (1) *Embryonic*; stable rifts (2) *Juvenile*; beginning of divergence (3) *Mature*; completely open & subduction begins (4) *Declining*; convergence; starting to close (5) *Terminal*; uplift and closure (6) *Suturing*; convergence & fully closed. This demonstration will help students visualize and interpret the Wilson's cycle.

SAFETY:

1. Allergies?
   a. Milky Way candies do **not** contain peanuts, but students may be allergic to other contents
   b. Check with students first!



ATP Energy Jar

Lauren Christine Burns

MATERIALS:

1. A large jar with a screw top lid, such as a mayonnaise jar or a canning jar
2. 3 strips of paper with the letter "P" written on them
3. A "snake in a jar" type spring-loaded novelty snake with the word "ENERGY" written or attached to it

SETUP:

Take two of the strips of paper with the letter "P" on them and fit them around the jar. Take the third strip and fit it around the lid of the jar. Place the spring-loaded novelty snake inside the jar and screw on the lid.

PROCEDURE:

After teaching the ATP/ADP cycle, show the students the jar with the lid on it. This jar represents a molecule of ATP. Remove the lid and the snake will spring out.

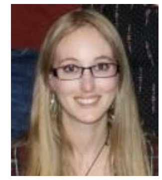
EXPLANATION:

When the lid with the third "P" on it is removed the "ENERGY" snake springs out showing how energy is released when a phosphate is removed. Ask the students what molecule remains and they should say ADP because of the two "P's" on the jar. When ADP is converted to ATP, a phosphate group is required and it takes energy to phosphorylate the ATP. Show how you have to "work" to get the snake back in the jar. Put the lid back on and show how energy is now stored in the molecule.

SAFETY:

Be sure to point the jar away from people when opening it.

Diagram



The Black Whole

Lauren Christine Burns

MATERIALS:

1. A coffee can which has been specially constructed (a slanted metal or plastic piece attached on the inside to keep water in).
2. A glass of water.

SETUP:

When making your coffee can the metal or plastic piece on the inside should be slanted down towards the bottom of the can. That way when the can is tipped on its side it will hold in the water better. Using the lid of the coffee can works well since it is already the correct shape and diameter. A hidden mark can be made on the inside rim of the can so that you can easily tell which way to tilt it.

PROCEDURE:

1. Hold the coffee can above the observers to ensure that they cannot view what is inside it.
2. Pour a glass of water directly into the coffee can. Note: do not let observers see inside the coffee can.
3. Tip the can over onto the side which will allow no water to spill out of the coffee can.

QUESTIONS:

1. Describe exactly what you observed.
2. Based on your observations, describe or draw what might be in the coffee can.
3. Are you making an educated guess about what occurred?
4. What is the scientific word for making an educated guess?
5. How might you collect further information to support your educated guess?
6. Write down some examples in which scientists have made educated guesses about natural events that occur to try to explain what is happening in the world.

EXPLANATION:

This demonstration is an excellent way to introduce the Scientific Method because it deals with observing and recording those observations. Furthermore, the students can make an educated guess (hypothesis) about what might be occurring.

Students can also be introduced to the idea that in science there are many wonders that scientists cannot fully explain. Scientists can only make observations and try to collect as much information as possible and based on the knowledge they gain from these observations they can hypothesize about what is happening. For example, scientists did not actually see the dinosaurs that lived during the Triassic Period, however they can predict because of the evidence that was left behind in the fossil record.

It is important to inform the students that even though their educated guess about what was inside the coffee can was correct they would have to do millions of tests to definitively state that it was. This is because in order for a hypothesis to become a fact or a theory an enormous amount of data must be collected to support the hypothesis and millions of tests must have taken place.

Diagram

Mystical Cylinder

Lauren Christine Burns

MATERIALS:

1. A large print-out of the words TITANIUM DIOXIDE (must be in all capital letters).
2. A cylinder filled with water and closed at the top so it can be turned sideways (a smooth water bottle without bumps or ridges works well for this).

SETUP:

When filling your cylinder with water try to make sure that there is no air bubble or only a very small one. A large air bubble may interfere with student's ability to see the effect.

For the print-out of TITANIUM DIOXIDE a plain sans serif font works best. The height of the letters should be about the same as the width of the cylinder being used.

PROCEDURE:

1. Tell the class that you have special cylinder and have them watch what it does.
2. Hold the cylinder of water in front of the words TITANIUM DIOXIDE. See what happens.

QUESTIONS:

1. Why does the word TITANIUM invert and the word DIOXIDE does not?
2. Why does the cylinder invert the words?

EXPLANATION:

Both words actually invert, however when the word DIOXIDE inverts it still appears the same. This is because all of the letters in that word look the same whether right side up or upside down.

This demo can be used to start a discussion about science and how a scientist has to think everything out. A scientist should not be easily tricked.

This can also be used as a discussion of lenses and why the cylinder causes the letters to invert.

Diagram

Now You See It, Now You Don’t

Lauren Christine Burns

MATERIALS:
1. A small white candle
2. An apple
3. Lemon juice
4. An almond
5. Matches or a lighter

SETUP:
Skin the apple and soak it in lemon juice to prevent it from browning. Carve the apple into the shape of a candle as similar in size and shape as possible to the real candle you are using. Carve the almond into the shape of a wick and poke it into the top of the apple to complete your apple candle.

PROCEDURE:
1. Light the candle and give it to the audience so that they can observe it.
2. While they are observing the candle, light the apple with the almond wick.
3. Show the apple/almond “candle” to the audience.
4. Blow the apple/almond “candle” out and quickly eat it.

TIPS:
Be sure to practice this a few times to make sure your apple “candle” works and is convincing.

QUESTIONS:
1. What do you know about candles?
2. Based on previous knowledge you have on candles, are they edible?
3. Is it possible that what we already know about candles (they are not edible) could be incorrect?
4. How do we know if candles are edible or not?
5. Do you think that the second candle (the edible candle) was really a candle? Why or why not?
6. In science, what is it called when we assume without actually observing it?
7. Why did we infer that the second candle (the edible candle) was really a candle?
8. Name 3 different examples of inference.

EXPLANATION:
This demonstration is a great tool to introduce the idea of inference. It is important for students to understand and distinguish the difference between inference and observation.

The first candle was given to the students to observe. In this instance they could easily tell that the candle was made out of wax and was indeed a candle. However, the second candle the students were not able to observe using all their senses. Instead they had to rely on seeing which as we know is not always reliable.

This demonstration teaches students that it is important in science to be observant and try not to make inferences.

SAFETY:

This demo involves candles with an open flame. Be sure to handle with care and instruct students to do the same. Keep all flammable material such as paper as well as loose and hanging items well away from the flame. **Be sure to blow out the apple/almond "candle" before eating it!**

Diagram

Magic Coin

Danielle Thuringer - Biology Post-Bac

MATERIALS:
Glass Bottle
Quarter
Ice Water

PROCEDURE:

Dip a quarter and the neck of a glass soda bottle into a bowl of cold water. Allow them to sit for five minutes. Take them out and place the bottle right side up. Put the coin over the opening of the bottle, then cover the bottle with both hands for 15 seconds. Remove your hands and watch the coin pop up.

EXPLANATION:

The coin jumps because the hands create heat inside of the bottle, which causes the air inside to expand and create pressure. Once enough pressure is created, it slowly releases the hot air through the top of the bottle, causing the coin to move.

Candy Blood

Danielle Thuringer - Biology Post-Bac

MATERIALS:
Candy Red Hots
Corn Syrup
Marshmallows or white jellybeans
Candy sprinkles
Glass or other clear container

PROCEDURE:

Mix the ingredients in a large clear container while explaining the four components of blood and the relative amounts of each.

TIPS:

Optional: Give students spoons and small paper cups and let them sample the candy blood!

EXPLANATION:

- Red blood cells (candy red hots): 44% of blood volume, carry oxygen and carbon dioxide around body. RBC's only live for about 3 months, but are continuously produced in the bone marrow.
- Plasma (corn syrup): 55%, syrups, thick, clear, yellowish liquid that carries dissolved food and wastes.
- White blood cells (white jelly beans or marshmallows): 0.5%, bigger than red blood cells, oddly shaped cells that "eat"☐ bits of old blood cells and attack germs.
- Platelets: 0.5% -bits of cells and cytoplasm that help clot your blood.

Groundwater Pollution

Danielle Thuringer - Biology Post-Bac

MATERIALS:

Slice of white bread
Food coloring
Water
Pipette

PROCEDURE:

Place a drop of food coloring on the top crust edge of the bread. Use a pipette to add at least 2mL of water to the food coloring. Hold the bread upright (vertically) for a few minutes while the dye soaks down the bread.

TIPS:

Use two different colors to represent two different sources.

EXPLANATION:

The bread represents the earth and the food coloring represents pollution. When it rains, the water carries these pollutants into the ground with it, which in turn pollutes our groundwater. The food coloring spreads out, rather than going straight down, making it difficult to determine the source of the pollutant.

Disappearing Test Tube

Danielle Thuringer - Biology Post-Bac

MATERIALS:
Wesson vegetable oil
Water
Pyrex glassware (test tube, beaker, stirring rod)

PROCEDURE:

Put a piece of lab glassware into a large beaker of water, taken note that it is still visible. Add the same type of glassware to a beaker of vegetable oil. The glassware will seem to disappear! You can also fill a beaker half with water and half with vegetable oil to observe the glassware in both liquids.

PROCEDURE (ALTERNATE):

A test tube is placed in the vegetable oil before the lecture. During the lecture, the lecturer smashes another test tube in an envelope and pours it into the oil and stirs it. Then reaching in with a pair of tongs is able to pull a whole test tube out of the oil, telling the students it was put together with a magic fluid.

EXPLANATION:

Pyrex glass has the same index of refraction as the vegetable oil, making the glassware seem to disappear. When light moves from one medium to another, it generally bends slightly. This is because the properties of the media allow light to move through them at different speeds. When light hits the change in media at an angle, one side of it moves faster than the other. This is like planting one foot and moving the other - you'll twist around. The light does the same. People can see window glass and clear water mostly because light distorts between the glass or water, and the air. People can also see the distortions between the pyrex and the air. By coincidence, though, there is no difference in the speed of light through vegetable oil and through pyrex. No distortions, and no tinting to the pyrex, mean that no one can see the difference between them. Surrounded by oil - the pyrex disappears.

Fresh Water-Apple Analogy

Danielle Thuringer - Biology Post-Bac

MATERIALS:
Apple
Knife

PROCEDURE:

1. Hold the apple in front of you and tell the students that it represents all the water on the earth. Ask them to guess how much they think is salt water. Cut the apple in fourths, three of which are set aside.

2. Take the remaining fourth and cut it in half. Add that to the rest of the pile you have set aside. Tell the students that the large pile is all the water in the world that is salty (97.4%).

3. Ask them if they think the remaining 2.6% of the apple (water) is available for our use. What form of water is not available? Cut the remaining sliver in thirds. Discard 2/3 of it, as it represents the frozen water that cannot be used (polar ice caps and glaciers= 2.0%).

4. Of the remaining sliver take off the peel as it represents some polluted water. The remaining 0.6% is all the useable water on earth! Let students know that includes all rainwater.

Holy Water

Abby Lundien – Earth Sciences Senior

MATERIALS:

- Clear Glass
- Water
- Powdered Sugar

PROCEDURE:

- Fill a glass until it is overflowing with water and the full amount remains over the lip of the glass.
- Slowly sprinkle powdered sugar on top of the water, taking care to not overflow the glass.

EXPLANATION:

This demonstration is to show the space between molecules. By adding powdered sugar to a glass of water that appears to be full, and it not overflowing, it demonstrates that there is still room in the glass, which is in between the molecules.

Hanging Water

Abby Lundien-Earth Sciences Senior

MATERIALS:

- Water
- Nylon
- Rubber band
- Mason jar with ring
- Card stock

PROCEDURE:

- Fill up Mason jar with water.
- Put a few drops of food coloring in the water so it is easier to see.
- Place a piece of nylon without seams over the top of the glass.
- Secure it by screwing on the ring
- Place a piece of card stock on top of the jar
- Slowly turn the glass of water upside down
- Remove the card stock from underneath the jar

EXPLANATION:

This demonstration shows the effects of air pressure and the surface tension of water. When the glass is turned upside down, no water should fall out due to the pressure that is pushing up on it mixed with the surface tension of the water that is enhanced by the piece of nylon.

Compass

Abby Lundien- Earth Sciences Senior

MATERIALS:

- Bowl of water
- Needle
- Cork
- Magnet

PROCEDURE:

- Magnetize the needle by rubbing it on the magnet.
- Push the needle all the way into the cork.
- Place it into the bowl of water and it should float.
- Move the magnet around the outside of the bowl and the needle should follow it.
- Remove the magnet and it should return to pointing towards magnetic north.

EXPLANATION:

This represents to students how a compass works as well as why magnets point to magnetic north. This could be expanded to represent the changing of the direction of the magnetic pole, and how it creates the shift in the orientation of the magnetism in lava coming out of the Mid Atlantic ridge.

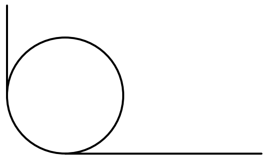
Fire by Steam

Matt Shade – Earth Science Senior

MATERIALS:
Hot Plate
Erlenmeyer flask
Rubber Stopper for Erlenmeyer flask
Flexible Copper Tubing, 1/4'', roughly 5' long
Strike Matches
Tongs
Propane torch.

SETUP:

First, coil the flexible copper tubing approximately 3-4 times around an "imaginary" circle with a diameter of approximately 4-5 inches. Leave both ends pointing 90 degrees away from each other with approximately 4-6 inches left on each end. Refer to image below.



Next, insert one end of the copper coil through the rubber stopper. If your rubber stopper does not have a hole for an object to be inserted through it(like a thermometer), you can also drill a hole roughly ¼'' in diameter. The end of the copper coil should go through the rubber stopper with 1-2 inches of copper showing.

Now, fill the Erlenmeyer flask roughly $1/4^{th}$ full with water and stopper with the copper coil/rubber stopper. The copper coil may be too heavy for the Erlenmeyer flask to safely support; if so, build an apparatus to provide that support.

Finally, place the Erlenmeyer flask on the hot plate, and have matches and propane torch on hand along with necessary precautionary equipment (fire extinguisher, etc).

PROCEDURE:

Begin by turning on the hot plate and wait for the water to boil (you may add a boiling chip if you wish). Once the water in the Erlenmeyer flask has come to a rolling boil, use the propane torch to heat up the copper coil. The best place to point the torch is into the coils themselves- stay away from the ends of the copper, especially the end with the rubber stopper. This super-heating process may take 20-30 seconds or more. Once the gas exiting the copper tubing has turned colorless(you are no longer seeing the steam), take a match, put it in tongs, and place the head of the match directly in front of the exiting stream of steam.

TIPS:

EXPLANATION:

Quite simply, once the steam is superheated, it now has the energy required to light a match.

First and foremost, this is a demonstration meant to convey the true power that steam can have. When normal steam is created from a pot of boiling water, it turns into vapor at 212 degrees Fahrenheight(standard pressure) and no more. However, this temperature is nowhere close enough to power the immense turbines in coal power plants, which provide roughly 70% of our nation's energy. These power plants superheat their steam to temperatures reaching 1000 degrees Fahrenheight, allowing them to reach much higher levels of energy efficiency. One way they reach these super high temperatures is they pump steam through pipes and superheat those pipes.

This demo would go well with any unit dealing with energy or energy sources.

SAFETY:

Do not, under any circumstances, put any body part or foreign object in front of the steam exit point. This experiment should be conducted on a fire-safe surface. Participants should not wear clothing with loose components, such as a tie. Fire extinguishers should be on hand.

Prior to setup, you may want to ensure that the copper pipe is free of foreign objects by blowing through one end. This prevents any situation where dangerous levels of pressure would build up within the Erlenmeyer flask while boiling the water.

Water vs. Steel

Matt Shade – Earth Science Senior

MATERIALS:

Steel Pipe, roughly ½'' diameter, roughly 6 inches long, threaded on both sided (inside or out).
Caps or plugs for the steel pipe.
Refrigerator

SETUP:

Begin by capping one end of the steel pipe. Then, fill the steel pipe to its brim with water(this part is critical, you do not want any air in the pipe). Very carefully, without spilling any water, seal the 2nd end of the pipe. Tighten the caps as tightly as possible

PROCEDURE:

After you have filled the steel pipe with water and tightly capped it, put it in a refrigerator for approximately 3-5 hours. Depending upon the strength of the pipe, size of the pipe, etc, you may have to wait a while. Once the appropriate time has passed, the pipe should have split and you can take it out and use it as a demo.

TIPS:

Black steel pipe is cheap and can be bought at most hardware stores.

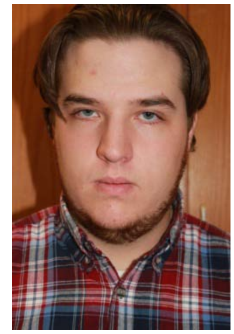
EXPLANATION:

This demonstrates the extremely powerful forces behind expanding water. As the water freezes, it attempts to form crystal lattices which take up more space than when it was in liquid form. Water cannot freeze without forming these crystals. As such, the colder the water gets, the more force it will exert onto the steel pipe as it attempts to freeze (until it overcomes the steel).

This demo also shows the incredible forces that water can exert during the erosion process of granite in mountains.

SAFETY:

If you freezer also contains glass or other delicate items, put the pipe into a towel. When the pipe bursts, it will jump.



Lake Overturn

Matt Shade – Earth Science Senior

MATERIALS: (CALIBRI 11 FONT IN ALL CAPS, UNDERLINED AND RED)

2 Jars that can stack on top of each other safely (mason works well).
One container of warm/hot water that can overfill one jar
One container of cold water than can overfill one jar
A laminated card large enough to completely cover the lid of one jar.
Large tub
Food Coloring, Blue and Red work best

SETUP:

Fill one jar to the very brim with warm water, and add food coloring (red). Now, fill the other jar to the brim, and add a different food coloring (blue). Make sure to do this just prior to the demo; the greater the temperature difference between the two liquids, the better. Put both jars into the large tub.

PROCEDURE:

On top of the lid of the warm jar, place the laminated card. The card should make a tight seal against the lid of the jar due to the water. Next, very, very carefully tip the jar over, keeping one hand on the bottom of the jar and one hand on over the card. When you do this, no water should fall out. Then, just as carefully, place the warm jar upside down on top of the cold jar. Essentially, the lids of both jars would be touching together if not for the card in between. Carefully remove the card from between the two jars, allowing the two liquids to touch. Because the warm liquid is on top, no mixing of colors should occur.

When ready to demonstrate what happens when a lake overturns, very, very, very carefully grasp both jars, lift them up without separating them or allowing any liquid to escape, and flip them. Make certain to do this over the tub just in case.

TIPS:

Make certain the laminated card is as thin and stiff as possible. Anything as flimsy as an overhead will fail. Practice, practice, practice the flipping portion; when the jars are filled with water, they can be heavy and difficult to deal with. Be sure not to make your "hot" liquid too hot, the heat will transfer easily through the jars.

EXPLANATION:

Large bodies of water, such as lakes and oceans, often segregate themselves based upon density. Density can be influence by salt content, but density is most influenced by temperature. In these bodies, less dense, or warmer, waters tend to float above more dense, cooler waters. During summer, density remains relatively stable in lakes because the top is warmed by the sun, while the bottom remains cool against the earth. During winter, however, lakes (especially lakes in Colorado) undergo a process known as overturning. This is where the top of a lake becomes significantly cooler (denser) than the bottom, and the lake itself flips from the bottom up. This is a very, very important process for the health of a lake because during summer, the top of a lake begins to lose nutrients as those nutrients slowly fall towards the bottom of the lake. Conversely, as fish move deeper to gain access to these nutrients, they begin to deplete oxygen at lower depths. This results in lakes which are nutrient deficient near the top and oxygen deficient at the bottom. The process of overturning mixes the lake, and brings oxygen to the bottom and nutrients to the surface, resulting in a much healthier ecosystem. Oceans do this too, but by much different mechanisms.

This demo is best done during any unit on oceans, marine ecosystems, or density and temperature.

SAFETY:

Bring a spare pair of pants the day you do this, just in case.